

REMARKS

I. Introduction

By the present Amendment, claims 1, 2, 10, and 11 have been amended. No claims have been added or cancelled. Accordingly, claims 1-13 remain pending in the application. Claims 1 and 10 are independent.

II. Office Action Summary

In the Office Action of September 30, 2005, the abstract was objected to under 37 C.F.R. §1.72. The disclosure was objected to because of an informality. Claims 6 and 13 were objected to because of several typographical errors. Claims 1-13 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent 5,942,342 issued to Hikosaka et al. ("Hikosaka") These rejections are respectfully traversed.

III. Objections to the Specification

The Abstract of the application was objected to under 37 C.F.R. §1.72. With respect to this objection, the Office Action indicates that the Abstract should avoid using phraseology commonly used in the claims. The Office Action also indicates that the Abstract should be concisely written in 50-150 words.

By the present amendment, Applicants have made appropriate corrections to the Abstract and submitted a substitute Abstract to be included in the application.

Withdrawal of this objection is therefore respectfully requested. The new Abstract addresses the issues raised in the Office Action.

The disclosure was objected to because of minor informalities. Regarding this objection, the Office Action identifies an instance where a typographical error

appears to have been made. Specifically, page 4, line 27 includes the word "id" instead of --is--.

By the present amendment, Applicants have revised the specification to correct this error.

Accordingly, this particular objection should be withdrawn.

IV. Claim objections

Claims 6 and 13 were rejected to because of several typographical errors. Specifically, the Office Action indicates that claim 6 has a typographical error in line 2, and claim 13 has a typographical error in line 6.

By the present amendment, claims 6 and 13 have been amended to correct these typographical errors.

Withdrawal of this objection is therefore respectfully requested.

V. Rejections Under 35 USC §102

Claims 1-13 were rejected under 35 U.S.C. §102(b) as being anticipated by Hikosaka. With respect to claim 1, the Office Action indicates that Hikosaka discloses a perpendicular magnetic recording medium that comprises a soft magnetic layer and a perpendicular recording layer which are deposited over a substrate in said in this particular order. The soft magnetic underlayer purportedly comprises a first soft magnetic layer, a domain control layer which includes at least an anti-ferromagnetic layer, and a second soft magnetic layer. The Office Action indicates that a ratio of d_1 over d_2 falls within a range of 0.3 to 1.5. Further, the Office Action indicates that the limitation of the coercivity H_c being smaller than the exchange bias field H_{ex} in the radial direction is explicitly taught. The Office Action

also provides citations to various passages in the reference where these features are allegedly disclosed. Applicants respectfully disagree.

As amended, independent claim 1 defines a perpendicular magnetic recording medium that comprises:

a soft magnetic underlayer and a perpendicular recording layer which are deposited in this order over a substrate,

said soft magnetic underlayer consisting of a first soft magnetic layer, a domain control layer which includes at least an anti-ferromagnetic layer, and a second soft magnetic layer in this order from said substrate,

wherein the energy of the exchange bias field Hex2 which is applied to said second soft magnetic layer is larger than the energy of the exchange bias field Hex1 which is applied to said first soft magnetic layer, and

wherein, in a magnetization curve of said soft magnetic underlayer, measured when a magnetic field is applied in a radial direction of the substrate, a magnetization reversal slope occurs at a shift toward a positive direction of energy of the magnetic field and coercivity Hc of the soft magnetic underlayer, which is obtained from the magnetization curve, is smaller than the energy of the exchange bias field (which corresponds to the shift quantity) Hex.

According to claim 1 the perpendicular magnetic recording medium has a soft magnetic underlayer and a perpendicular recording layer which are deposited over a substrate and a specific order, i.e., the magnetic underlayer being deposited before the perpendicular recording layer. The soft magnetic layer consists of a first soft magnetic material, a domain control layer which includes at least an anti-ferromagnetic layer, and a second soft magnetic layer. Additionally, these three layers are deposited in this specific order relative to the location of the substrate. According to the invention of claim 1, the energy of the exchange bias field (Hex2) which is applied to the second soft magnetic layer is larger than the energy of the exchange bias field (Hex1) which is applied to the first soft magnetic layer. Furthermore, when a magnetic field is applied in a radial direction of the substrate, the resultant magnetization curve of the soft magnetic underlayer exhibits a

magnetization reversal slope at a shift toward a positive direction of energy of the magnetic field and coercivity (H_c) of the soft magnetic layer that is smaller than the energy of an exchange bias field H_{ex} which corresponds to the shift quantity.

The Office Action alleges that Hikosaka discloses the features of the claimed invention. In particular, the Office Action indicates that Hikosaka discloses a soft magnetic underlayer that includes a first soft magnetic layer, a domain control layer which includes at least an anti-ferromagnetic layer, and a second soft magnetic layer disposed in this particular order on a substrate. The magnetic recording medium of Hikosaka, however, differs from that of the claimed invention. Hikosaka discloses a magnetic recording medium that comprises a multiplicity of soft ferromagnetic underlayers. In contrast, the magnetic recording medium of independent claim 1 contains only two soft magnetic layers. For example, Figure 5 of Hikosaka discloses a magnetic recording medium that contains 15 soft magnetic underlayers. Further, Hikosaka appears to teach away from the claimed invention in that it describes various disadvantages associated with a magnetic recording medium having a small number of soft magnetic layers. See column 9, line 36 to column 10, line 16, and Figure 4.

Next, the Office Action indicates that Hikosaka discloses the feature of the lowermost soft magnetic layer having a different exchange bias field than the other soft magnetic layers. As amended, however, the magnetic recording medium of independent claim 1 is configured such that the energy of the exchange bias field (H_{ex2}) which is applied to the second soft magnetic layer is greater than the energy of the exchange bias field (H_{ex1}) which is applied to the first soft magnetic layer. This particular feature differs from the teachings of the reference. Hikosaka merely discloses that a different exchange bias field is applied to the lowermost soft

magnetic layer than the exchange bias fields applied to the other soft magnetic layers. In particular, Hikosaka does not appear to provide any disclosure or suggestion for which exchange bias field is larger when only two soft magnetic layers are provided. This is to be expected, however, since Hikosaka teaches away from providing a small number of soft magnetic layers such as two.

It is therefore respectfully submitted that independent claim 1 is allowable over the art of record.

Claims 2-9 and 13 depend, either directly or indirectly, from independent claim 1, and are therefore believed allowable for at least the reasons set forth above with respect to independent claim 1.

In addition, these claims each introduce novel elements that independently render them patentable over the art of record.

As amended, independent claim 10 defines a perpendicular magnetic recording medium that comprises:

- a soft magnetic underlayer and a perpendicular recording layer which are deposited in this order over a substrate,

- said soft magnetic underlayer consisting of a first soft magnetic layer, a domain control layer which includes at least an anti-ferromagnetic layer, and a second soft magnetic layer in this order from said substrate,

- wherein the energy of the exchange bias field Hex2 which is applied to said second magnetic layer is larger than the energy of the exchange bias field Hex1 which is applied to said first soft magnetic layer, and

- wherein, in a magnetization curve of said soft magnetic underlayer, measured when a magnetic field is applied in a radial direction of the substrate, a magnetization reversal slope occurs at a shift toward a positive direction of energy of the magnetic field and coercivity Hc of the soft magnetic underlayer, which is obtained from the magnetization curve, is smaller than the energy of the exchange bias field (which corresponds to the shift quantity) Hex.

- wherein said domain control layer further includes one or two ferromagnetic layers and said two ferromagnetic layers are formed between said anti-ferromagnetic layer and the first soft magnetic layer and between said anti-ferromagnetic layer and the second soft magnetic layer or said one ferromagnetic layer is formed

between said anti-ferromagnetic layer and the first soft magnetic layer or the second soft magnetic layer.

Similar to independent claim 1, independent claim 10 provides only two soft magnetic layers that are disposed in a specific order from the substrate. Additionally, the energy of the exchange bias field (Hex2) which is applied to the second magnetic layer is larger than the energy of the exchange bias field (Hex1) which is applied to the first soft magnetic layer. As previously discussed, the applied references relate to magnetic recording media that contain plural soft magnetic layers. The applied references also appear to teach away from magnetic recording media that have a small number of soft magnetic layers. Additionally, the applied references do not appear to disclose the feature of the second exchange bias field (Hex2) being greater than that of the first exchange bias field (Hex1) within a magnetic recording medium which contains only two soft magnetic layers..

It is therefore respectfully submitted that independent claim 10 is allowable over the art of record.

Claims 11-13 depend from independent claim 10, and are therefore believed allowable for at least the reasons set forth above with respect to independent claim 10. In addition, these claims each introduce novel elements that independently render them patentable over the art of record.

VI. Conclusion


For the reasons stated above, it is respectfully submitted that all of the pending claims are now in condition for allowance. Therefore, a Notice of Allowance is believed in order, and courteously solicited.

If the Examiner believes that there are any matters which can be resolved by way of either a personal or telephone interview, the Examiner is invited to contact Applicants' undersigned attorney at the number indicated below.

AUTHORIZATION

Applicants request any shortage or excess in fees in connection with the filing of this paper, including extension of time fees, and for which no other form of payment is offered, be charged or credited to Deposit Account No. 01-2135 (Case: 520.43257X00).

Respectfully submitted,
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